We claim:

1. A process for removing sulfur from a hydrocarbon comprising:

conveying a feed stream past a first side of a solid membrane, wherein said feed stream comprises a feed liquid hydrocarbon and a feed sulfur species;

conveying a sweep stream past a second side of said solid membrane;

transporting said feed sulfur species from said feed stream through said solid membrane in a permeate into said sweep stream, thereby converting said sweep stream to a sulfur-enriched stream and said feed stream to a substantially sulfur-free reject stream containing a primary hydrocarbon product.

2. The process of claim 1 wherein said sweep stream comprises a sweep liquid hydrocarbon.

3. The process of claim 2 wherein said sweep liquid hydrocarbon is selected from the group consisting of naphtha, diesel, cycle oil, and mixtures thereof.

4. The process of claim 1 wherein said feed sulfur species is substantially more membrane permeable than said feed liquid hydrocarbon.

5. The process of claim 1 wherein said sweep stream is substantially smaller than said feed stream.

6. The process of claim 1 wherein the weight ratio of said sweep stream to said feed stream is below about 0.2.

7. The process of claim 1 wherein said feed liquid hydrocarbon is a conventional refinery hydrocarbon stream.

8. The process of claim 1 wherein said feed liquid hydrocarbon is selected from the group consisting of naphtha, diesel, and mixtures thereof.

9. The process of claim 1 wherein said feed sulfur species is selected from the group consisting of an organic sulfur compound, elemental sulfur, hydrogen sulfide and combinations thereof.

10. The process of claim 9 wherein said organic sulfur compound is selected from the group consisting of thiols, alkylated thiols, thiophenes, alkylated thiophenes, benzothiophene, alkylated benzothiophenes, dibenzothiophenes, alkylated dibenzothiophenes and mixtures thereof.

11. The process of claim 1 wherein said membrane is formed from a compound selected from the group consisting of nitrogen compounds, nitrogen

oxide compounds, oxygen compounds, sulfur compounds, sulfur oxide compounds, and mixtures thereof.

12. The process of claim 1 wherein said membrane is more selective for said feed sulfur species than said feed liquid hydrocarbon.

13. The process of claim 1 wherein said membrane contains a facilitated transport liquid.

14. The process of claim 13 wherein said facilitated transport liquid is selected from the group consisting of amines, hydroxyamines, alcohols, and mixtures thereof.

15. The process of claim 1 wherein said sweep stream comprises a decoupling agent species.

16. The process of claim 15 wherein said decoupling agent species is selected from the group consisting of amines, hydroxyamines, alcohols, sulfur compounds, and mixtures thereof.

17. The process of claim 1 further comprising distilling said sulfur-enriched stream to separate said feed sulfur species from said sweep stream.

18. The process of claim 17 further comprising recycling said sweep stream separated from said feed sulfur species to said second side of said solid membrane.

19. A process for removing sulfur from a hydrocarbon comprising:

conveying a feed stream past a first side of a solid membrane, wherein said feed stream comprises a feed liquid hydrocarbon and a feed sulfur species and wherein said solid membrane contains a facilitated transport liquid;

transporting said feed sulfur species from said first side into said solid membrane in a permeate;

complexing said feed sulfur species with said facilitated transport liquid to form a facilitated transport complex; and

transporting said facilitated transport complex through said solid membrane to a second side of said membrane, thereby converting said feed stream to a substantially sulfur-free reject stream.

20. The process of claim 19 wherein said facilitated transport liquid is selected from the group consisting of amines, hydroxyamines, alcohols, and mixtures thereof.

21. The process of claim 19 further comprising decoupling said at least one sulfur species and said facilitated transport liquid by contacting said facilitated transport complex with a decoupling agent species on said second side.

22. The process of claim 21 wherein said decoupling agent species is selected from the group consisting of amines, hydroxyamines, alcohols, sulfur compounds, and mixtures thereof.

23. A process for removing sulfur from a hydrocarbon comprising:

conveying a feed stream past a first side of a solid membrane, wherein said feed stream comprises a feed liquid hydrocarbon and a feed sulfur species;

conveying a sweep stream past a second side of said solid membrane, wherein said sweep stream comprises a membrane impermeable second liquid hydrocarbon;

transporting said feed sulfur species from said feed stream through said solid membrane in a permeate to said sweep stream, thereby converting said sweep stream to a sulfur-enriched stream and said feed stream to a substantially sulfur-free reject stream containing a primary hydrocarbon product; and

separating said permeate from said sweep stream in said sulfur-enriched stream.

24. The process of claim 23 further comprising hydrogenating said permeate after separating said permeate from said sweep stream.

25. The process of claim 23 further comprising hydrogenating said sulfur-enriched stream before separating said permeate from said sweep stream.

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DRAWING GLOSSARY; 990017 USA

10 membrane separation unit
12 feed inlet
14 reject outlet
16 sweep inlet
18 sulfur-enriched outlet
20 selective membrane
22 feed chamber
24 sweep chamber
26 distillation unit
28 hydrogenation unit
30 sulfur-enriched inlet
32 overhead outlet
34 bottom outlet
36 overhead inlet
38 hydrogen inlet
40 hydrogen sulfide outlet
42 water outlet
44 residual hydrocarbon outlet
46 sulfur-enriched line
48 sweep recycle line
50 overhead line
52 residual hydrocarbon line
54 intersection
56 hydrocarbon product line